

# ARPES Study of Metal-Insulator Transition Driven by Charge Ordering Localization in 2-D Nickel Oxides ( $\text{La}_{2-x}\text{Sr}_x\text{NiO}_4$ )

M.Z. Hasan<sup>1</sup>, X. Zhou<sup>1,2</sup>, A. Lanzara<sup>1,2</sup>, P. Bogdanov<sup>1</sup>, Z-X. Shen<sup>1</sup>, S. Kellar<sup>1,2</sup>  
E. D. Lu<sup>1</sup>, Z. Hussain<sup>2</sup>, I. Kyoko<sup>3</sup> and Y. Tokura<sup>3</sup>

<sup>1</sup>Department of Applied Physics, Physics & Stanford Synchrotron Radiation Lab of Stanford Linear Accelerator Center,  
Stanford University, Stanford, Ca 94305

<sup>2</sup>Advanced Light Source, Lawrence Berkeley National Lab, Berkeley, Ca 94720

<sup>3</sup>Department of Applied Physics, The University of Tokyo, Tokyo 113-0033, Japan

The physics of charge ordering in transition metal oxides have recieved a lot of research interest because of their possible connection to the phenomena of high T<sub>c</sub> superconductivity and colossal magnetoresistance [1-3]. The two dimensional ordering of doped charges are believed to exist most robustly in comensurately doped nickel oxides [4,5]. We have recently performed Angle-Resolved Photoemission Spectroscopy (ARPES) on  $\text{La}_{2-x}\text{Sr}_x\text{NiO}_4$  ( $x=1/3$ ,  $x=1/5$ ) using BL 10.0.1 at the Advanced Light Source to study how the single particle properties (spectrum) changes as the system goes through long-range charge stripe ordering. A clear feature around 1.3 eV binding energy is seen in all spectra which disperses about 250 meV to lower binding energies in going from (0,0) to ( $\pi,\pi$ ). This feature is believed to be the  $d^8L$  (doped hole complex) identified in earlier experiments [6]. This feature, in the  $x=1/3$  compound shows a strong temperature dependence in intensity near the charge ordering transition ( $T_{co} \sim 230$  K) where as the most of the valence band changes very little as a function of temperature. In addition to sharpening of the spectral intensity, the feature moves to higher binding energy at lower temperatures by about 200 meV. Sharpening of spectral intensity is also strongly k-dependent. A frequency integrated spectral intensity of this feature (partial  $n(k)$ ), for both the  $x=1/3$  and  $x=1/5$  compounds suggest a strong similarity to what would be expected from the undoped insulating AFM and consistent with Luttinger sum rule within the limits of experimental error bars. The anisotropic sharpening of the feature and its change in binding energy as a function of temperature near the metal-insulator transition can possibly be interpreted in terms of long-range ordering of doped charges. More systematic work is underway to check for this scenario.

- [1] S.A. Kivelson, E. Fradkin and V.J. Emery, *Nature* **393**, 550 (1998)
- [2] Y. Tokura and N. Nagaosa, *Science* **288**, 462 (2000)
- [3] X.J. Zhou et.al., *Science* **286**, 272 (1999)
- [4] S-W. Cheong et.al., *Phys. Rev. B* **49**, 7088 (1994)
- [5] T. Katsufuji et.al. *Phys. Rev. B* **54**, R14 230 (1996).
- [6] M. Satake et.al. *Phys. Rev. B* **61**, 15515 (2000)

## **Funding Information :**

This work performed at the Advanced Light Source beamline 10.0.1 of Lawrence Berkeley National Lab was jointly supported by the Department of Energy (Materials Science Division of Basic Energy Sciences) through Stanford Synchrotron Radiation Lab of Stanford Linear Accelerator Center, Stanford, California and by Department of Applied Physics of University of Tokyo, Tokyo, Japan .

## **Principal Investigator & Contact Information :**

Principal Investigator : Prof. Z.X. Shen Dept. of Applied Physics & Physics, Stanford University  
Contact Information : M. Z. Hasan [mzhasan@stanford.edu](mailto:mzhasan@stanford.edu), 650-723-8654